United States Department of Agriculture

Agricultural Research Service

USDA

Natural Resources & Sustainable Agricultural Systems
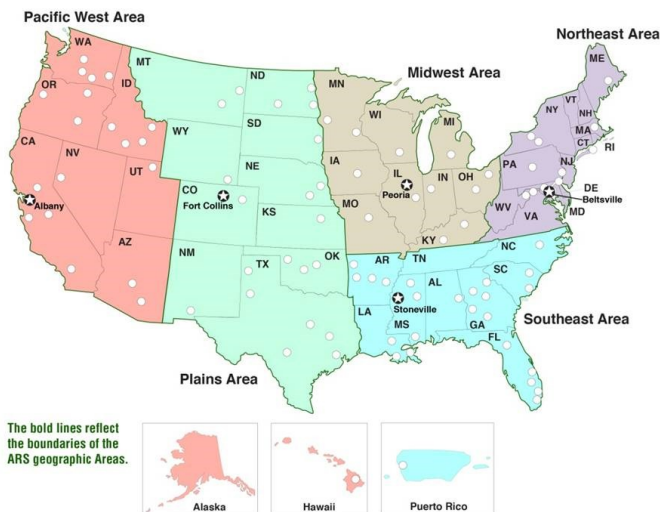
ARS Mission

The Agricultural Research Service conducts research to develop and transfer solutions to agricultural problems of high national priority and provides information access and dissemination to:

- ensure high-quality, safe food and other agricultural products
- assess the nutritional needs of Americans
- sustain a competitive agricultural economy
- enhance the natural resource base and the environment, and
- provide economic opportunities for rural citizens, communities, and society as a whole
- Provide the infrastructure necessary to create and maintain a diversified workplace.

ARS Locations

USDA **Agricultural Research Service Area Organization**

Pacific West Area

Northeast Area

Midwest Area

Albany

Fort Collins

Stoneville

Peoria

Beltsville

Southeast Area

Plains Area

The bold lines reflect the boundaries of the ARS geographic Areas.

Alaska   Hawaii   Puerto Rico

Natural Resources and Sustainable Agricultural Systems (NRSAS) supports researchers at 55 locations throughout the U.S. developing the technologies and strategies needed to help farmers, ranchers, and other natural resource managers become effective stewards of the diverse agricultural ecosystems across the Nation. Emphasis is given to developing economically efficient management practices and technologies that support profitable production and enhance the Nation's vast renewable natural resource base. Research priorities are identified through a continual dialog with a wide range of customers and stakeholders to ensure that our science is relevant and provides effective solutions to their concerns. We address issues affecting both private and public lands, because together these are the foundation of a healthy and vibrant agricultural industry that provides food, feed, fiber, and renewable energy to the Nation, while maintaining abundant and high quality supplies of fresh water, clean air, productive soils, and healthy ecosystems.

NRSAS Statistics:
Total Projects: 112
Total Locations: 55
Total Scientists: 407

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The ***Water Availability and Watershed Management*** program conducts fundamental and applied research on the processes that control water availability (quantity and quality) for the health and economic growth of the American people, and develops new and improved technologies for managing the Nation's agricultural water resources. These advances in knowledge and technologies provide producers, action agencies, local communities, and resource advisors with the practices, tools, models, and decision support systems they need

to improve water use efficiency in agriculture, enhance water quality, sustain and increase agricultural productivity and profitability, protect rural and urban communities from the ravages of droughts and floods, improve agricultural and urban watersheds, and prevent the degradation of riparian areas, wetlands, and stream corridors. The program focuses strongly on development of technologies to improve water resource management and, where appropriate, transfer of these for commercialization to ensure availability to users. Water is fundamental to life, and adequate quality and quantity are basic requirements for virtually all of our agricultural, industrial, urban, and recreational activities, as well as the sustained health of the natural environment.

Total Projects: 35
Total Locations: 25
Total Scientists: 132

This National Program is organized into four component areas:
- Effective Water Management in Agriculture
- Erosion, Sedimentation, and Water Quality Protection
- Enhancing and Documenting the Benefits of Conservation Practices
- Watershed Management to Improve Ecosystem Services in Agricultural Landscapes

National Program Leaders
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The ***Soil and Air*** program expands, maintains, enhances, and protects soil resources essential for U.S. agricultural production and minimizes any adverse impacts of agricultural management on air quality. Research under Soil and Air seeks to optimize the management of crop nutrients, reduce odor and emissions of ammonia and greenhouse gases (GHG) from agricultural production, and explore options for production management in the face of increasing weather extremes and climate change. Research under Soil and Air will aid in: a) ensuring the availability of soil resources needed to provide food, feed, fiber, and feedstock for an expanding global population; b) optimizing management strategies and practices that protect biological, chemical, and physical soil characteristics and enhance overall soil health and productivity, especially in the face of drought, saline buildup, and other challenges that result from weather related stress and climate change; c) reducing the loss of nutrient amendments, such as nitrogen and phosphorus, from agricultural landscapes; minimizing the release of particulate, odor-causing, volatile and greenhouse gas emissions; d) optimizing best management practices that reduce risks associated with pathogens, antibiotic resistant bacteria, and antibiotic resistance genes; and e) developing uses for agricultural, industrial, and municipal byproducts, including manure**.**
Total Projects: 22
Total Locations: 20
Total Scientists: 79
This National Program is organized into three component areas:
- Management and stewardship of soil resources
- Managing nutrients in agroecosystems
- Reducing environmental risk of agricultural operations

National Program Leader
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The ***Grass, Forage, and Rangeland Agroecosystems*** program provides research results that can be used to improve management decision making and enhance the utility, function, and performance of rangelands, pastures, forage, and turf agroecosystems while enhancing environmental and ecosystem services. Its vision is healthy, productive rangelands, pastures, forage cropping systems, and green spaces that support rural prosperity, food security, and earth's ecology.

Total Projects: 25
Total Locations: 22
Total Scientists: 92

This National Program is organized into four component areas:

- Provide fundamental knowledge and understanding of interacting ecological components of grass, forage, and rangeland agroecosystems.
- Improve the physiology and genetics of plant materials to enhance health, vitality, and utility of pasture, biomass for feed and fuel, rangeland, and turf systems.
- Develop integrated science-based tools to foster improved management of grass, forage, and rangeland agroecosystems.
- Generate strategies to manage grass, forage, and rangeland agroecosystems that simultaneously contribute to environmental conservation and are beneficial to human and animal use.

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The *Sustainable Agricultural Systems* research program develops agricultural systems to simultaneously attain the four goals of agricultural sustainability: meet yield quantity and quality needs, ensure producer economic viability, enhance environmental quality and the natural resources base, and enhance the quality of life for farmers, farm workers, and society as a whole. Using a focus on the interaction of genetics with environment and management (GxExM), production intensification and greater efficiency are sought via integration of new and proven practices, models and decision support systems, precision agriculture, automation, and remote sensing.
**Total Projects:** 30
Total Locations: 23
Total Scientists: 110

This National Program is organized into three component areas:

- Building Agroecosystems for Intensive, Resilient Production via GxExM Production System Economics
- Increasing Efficiencies for Agroecosystem Sustainability
- Achieving Agrocosystem Potential

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Long-Term Agro-ecosystem Research Sites and Farm Resource Regions
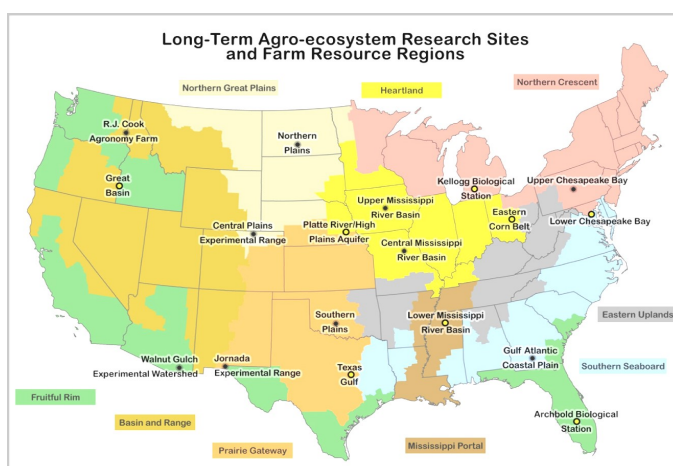
Natural Resources & Sustainable Agricultural Systems is also home to the ARS **Long Term Agroecosystem Research network (LTAR)**. The LTAR coordinates data collection and research scenarios at 18 locations to address the consequences of agricultural system performance when affected by changes such as variable and changing climate, markets, policy and technological innovation. Each of the 18 LTAR sites (see map) integrates agroecosystem research within the hydrologic basin/farm resource it represents, centered on one or more benchmark watersheds, experimental ranges, or research farms that already possess a rich history of historical datasets. At the broadest scale, the LTAR network addresses the question, "How can we sustain or enhance productivity, profitability, and ecosystem services in the Nation's agro-ecosystems and agricultural landscapes?" More information can be found at (www.ars.usda.gov/ltar).

ARS Data Management Efforts

Our goals for data management are to capture and distribute relevant data to the research community, especially modelers, in useable formats. Data include measured data, such as values of sediment in streams, and descriptive data such as the methods used for measuring the data. Data management includes the activities surrounding storing created data, describing stored data so that it can be used by others, finding data, obtaining data, and analyzing data for specific uses.

Current major data management efforts include:

CEAP (Conservation Effects Assessment Project) develops methods, tools, and data to quantify the effects of the USDA Conservation Programs by providing detailed assessments of conservation practices on watersheds. The diverse data from the watersheds are aggregated in a database delivery application known as STEWARDS (described below), which includes site data for weather, precipitation, soils, management, and water quality.

GRACEnet (Greenhouse gas Reduction through Agricultural Carbon Enhancement network) is a program that provides the research community with information concerning carbon storage in agricultural systems and information on nitrous oxide, methane, and other greenhouse gases (GHG) that may be emitted by agricultural practices. The GRACEnet database includes site data for weather, soils, land management, and measurement methods for net GHG emissions (carbon dioxide, nitrous oxide, methane) and carbon (C) sequestration.

REAP (Resilient Economic Agricultural Practices) provides the research community with information concerning soil implications of farm management practices used to grow crops for bioenergy production. The corresponding database includes data sets describing the geographic characteristics of research sites, soil chemistry, farm management practices, and economics impacts.

STEWARDS is a database delivery application for CEAP, GRACEnet, and REAP. STEWARDS is the baseline system for future natural resources database systems.

NUOnet (Nutrient Use and Outcome Network) is focused on the development of a nutrient management database. NUOnet aims to build the research and data connections among best management practices designed to increase nutrient use efficiency, reduce nutrient losses to the environment, and improve crop quality and nutritional value for animal and human health.

ARS-Developed Models

Our sophisticated and comprehensive modelers require extensive data to develop and validate their applications. The following are a subset of some of the powerful models ARS has developed:

SWAT (Soil and Water Assessment Tool) predicts the impact of land management practices on outflow of water, sediment, and agricultural chemicals over long periods of time.

WEPP (Water Erosion Prediction Project) model, is a physically-based simulation tool for estimating the effects of land management practices on runoff, soil loss, and sediment yield from hill slope profiles and small watersheds.

WEPS (Wind Erosion Prediction System) is a process-based, continuous, daily time-step model that simulates weather, field conditions, management, and wind erosion.

AGNPS (AGricultural Non-Point Source) pollution model predicts non-point source pollutant loadings within agricultural watersheds.

CQESTR simulates the effects of climate, crop rotation, and tillage management practices, and soil amendment additions on soil organic carbon (C).

RZWQM2 (Root Zone Water Quality Model) simulates the effects of major agricultural management practices on physical-chemical processes and plant growth, and the movement of water, nutrients, and pesticides to runoff and through the crop-root zone to shallow groundwater.

RUSLE2 (Revised Universal Soil Loss Equation) predicts rill and inter-rill erosion by rainfall and runoff.

NLEAP-GIS (Nitrate Leaching and Economic Analysis Package) allows users to assess the effects of management practices on nitrogen losses to the environment across diverse landscape and cropping system combinations.

RHEM (Rangeland Hydrology and Erosion Model) is designed to provide sound, science-based technology to model and predict runoff and erosion rates on rangelands and to assist in assessing rangeland conservation practice effects.
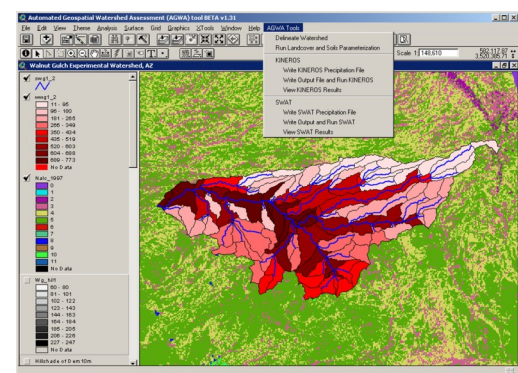
KINEROS2 (KINematic runoff and EROSion Model) is a physically-based watershed runoff and erosion model that employs the RHEM model as its hillslope hydrology and erosion engine.

AGWA (Automated Geospatial Watershed Assessment Tool) is a GIS-based hydrologic modeling tool that uses commonly available GIS data layers to fully parameterize, execute, and spatially visualize results for the RHEM, KINEROS2, and SWAT watershed runoff and erosion models.